



CH179X HIGH SPEED MODEM and FAX FAMILY

CH1799 / V.34bis - 33,600bps

CH1798 / V.34 - 28,800bps

CH1794 / V.32bis - 14,400bps

LL → *DL Line*

INTRODUCTION

The CH1799, CH1798 and CH1794 (CH179X Family) are industrial grade high speed modem modules capable of 33,600bps, 28,800bps and 17,400bps base rate data speeds, respectively. They can operate at even higher baud rates on DTE/DCE interface, with data compression software built in. The CH179X family is pin compatible with Cermetek's low cost CH1786 / V.22bis, 2400bps modem. Each module is a self-contained modem and is FCC Part 68 approved and Canadian DOC approvable. The ultra small modules are designed to be PCB mounted with through-hole mounting and are 1.35" x 1.38" x 0.58" in size. They have a serial V.24 interface to attach directly to a UART and Tip and Ring to the Telco Line. The units are controlled with standard AT Commands and are compatible with industry standard software. They operate on single 5V low power or on power standby mode.

Each unit supports a range of modem standards and speeds from 300bps to 14,400bps, 28,800bps or 33,600bps. This can be expanded up to the maximum DTE of 57.6kps or 115.2kbps respectively for the CH1794 and CH1798/CH1799, using data compression. A choice of error correcting algorithms may also be selected up through MNP 10 for cellular telephone operation. The CH179X also supports Send and Receive Fax capability.

GENERAL DESCRIPTION

The units are full function modems, refer to Figure 1, the functional block diagram. The CH179X Family consists of a serial interface buffer, modulator/demodulator, modem controller with error correction and data compression, non-volatile RAM and a DAA.

SERIAL HOST INTERFACE

The CH179X Family utilizes a serial V.24, EIA 232-E interface at 5 volts to control the modem. The CH179X Family can interface with the Data Terminal Equipment (DTE) at a fixed speed regardless of the modulation speed of a given modem connection. This eliminates the need to have the DTE step up or down in speed, based on a given incoming or outgoing communication data rate. Hence, the DTE can train the CH1799, to say 36.6kbps, and talk to a slower incoming data connection at say, 2400bps without changing host speed. The host DTE trained at 14.4kbps can also communicate with the modems at higher speeds, say 28.8kbps, but would require the built-in flow control to avoid lost data. The CH179X Family has a resident buffer to allow for this auto baud operation.

FEATURES

- Supports V.34bis, V.34, V.32bis, V.32, V.22bis, V.22A/B, V.23, V.21, Bell 212A and 103
- Data modem throughput up to 115.2kbps (CH1798/CH1799) or 57.6kbps (CH1794) with error correction
- Error correcting - V.42 LAMIP, MNP 2-4 and MNP 10 Data compression - V.42bis and MNP 5
- MNP 10 Data throughput enhancement for cellular operation
- DTE interface with speeds up to 115.2kbps (CH1798/CH1799) or 57.6kbps (CH1794)
- Automated baud rate adaptability utilizing speed sensing, flow control, and data buffers
- All versions support Send and Receive Fax Class 1, Group 3
- Serial V.24, 5 volt interface
- NVRAM directory and stored profiles
- AT Command structure, with extensions
- Built-in DAA with 1000 VAC isolation
- FCC part 68 Approved / DOC Approvable
- +5 Volt operation or zero power option
- Small size: 1.35" x 1.38" X 0.58"
- Pin compatible with CH1786, low speed / low cost 2400bps / V.22bis

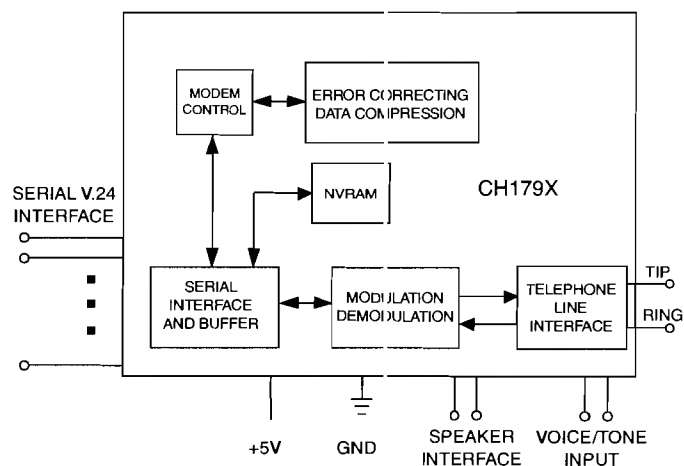


Figure 1. Functional Block Diagram

Automatic Speed/Format Sensing

Command Mode and Data Modem Mode: The modem can automatically determine the speed and format of the data sent from the DTE. The modem can sense speeds of 300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 19200, 38400, and 57600bps (CH1794) or 300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 16800, 19200, 21600, 24000, 26400, 28800, 38400, 57600 and 115200bps (CH1798/CH1799). The modem can sense the following data formats.

Parity	Data Length (No. of Bits)	No. of Stop Bits	Character Length (No. of Bits)
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*

* 11 bit characters are sensed, but the parity bits stripped off during data transmission in Normal and Error Correction modes.

The modem can sense data with mark or space parity and configures itself as follows:

DTE Configuration	Modem Configuration
7 mark	7 none
7 space	8 none
8 mark	8 none
8 space	8 even

The CH179X Family is trained to a selected speed with an AT [CR] training sequence. Thus, DTE, to modem interface speed, is locked in regardless of the connecting speed of a remote modem, (with minor restrictions, see the AT+MS command). This allows for selection of a modulation speed which the modem will support. The DTE modem interface speed should be set to the highest modulation speed to avoid the use of flow control. Flow control facilitates communication with higher speed modems by the DTE so that the data is not lost.

Modulation/Demodulation/ Error Correcting / Data Compression

Modulation/Demodulation uses an industry standard modem chip set which has been adapted for use with the CH179X Family. The Modulation/ Demodulation supports the following industry modem standards:

Bell 103	CCITT V.22
Bell 212A	CCITT V.22bis
	CCITT V.32
	CCITT V.32bis
	CCITT V.34
	CCITT V.FC
	CCITT V.34bis

The units support the following error correcting protocols: V.42 LAMP, MNP 2-4, MNP 10. The CH1799/CH1798 and CH1794 modems support V.42bis and MNP5 data compression, allowing data transmissions of 115.2kbps and 57.6kbps respectively. These DTE speeds are supported by the modem serial interface with auto baud capability. Note the maximum speed is limited by the maximum speed available from the DTE, up to 115.2kbps.

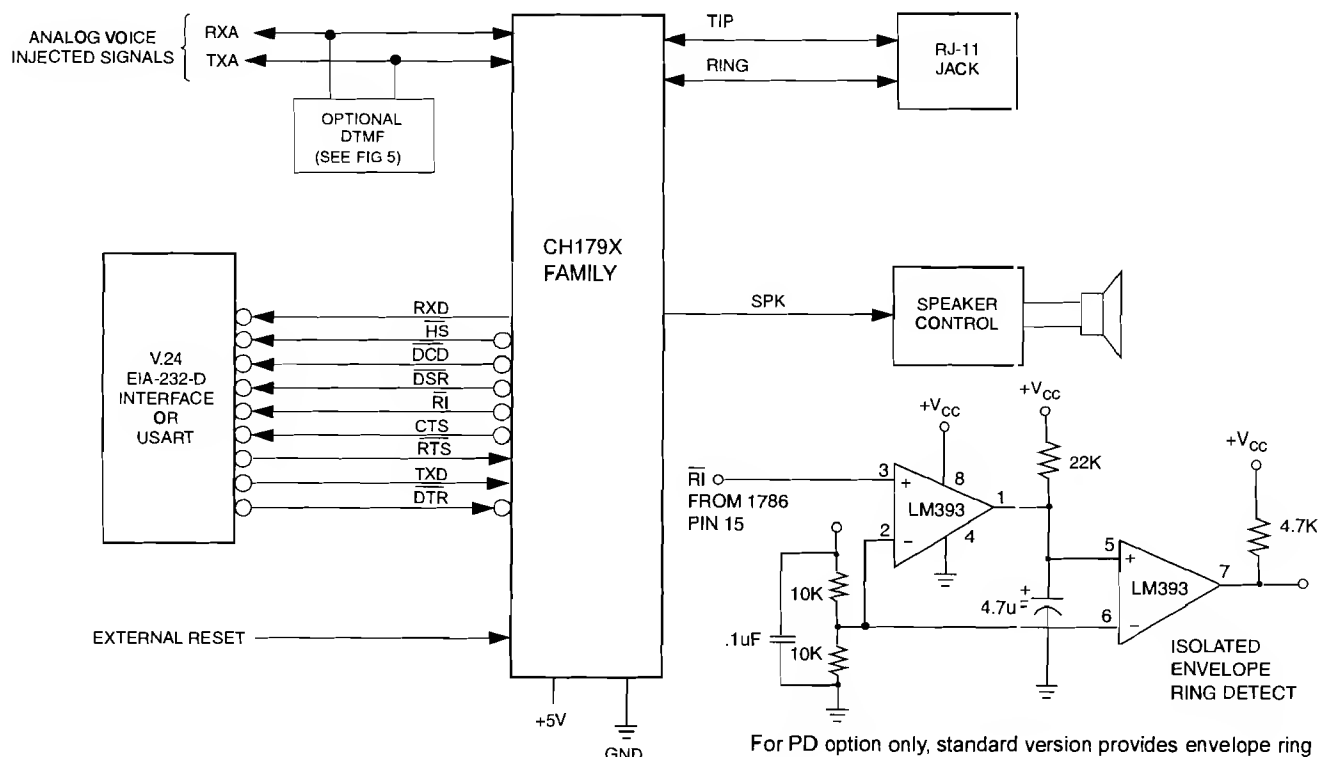


Figure 2. CH179X Family Application Diagram

The CH179X Family of devices support the AT Command set with extensions and can operate with industry standard communication software. The commands are compatible with TR302.2/88-08006.

The CH179X Family operates in asynchronous mode and supports a 5V, RS232-like interface - V.24 (EIA-232-D).

The resident Modulator/Demodulator supports line equalization and forward error correction required at higher speed data rates.

Non-Volatile RAM (NVRAM)

NVRAM can store two user-customized modem configurations. The AT&Wn command will store the active modem configuration in one of two NVRAM locations as selected by an n of 0 or 1. The AT&Yn command selects one of the stored modem configurations to be automatically recalled and active upon a reset or power up. The ATZn command immediately recalls and activates a stored configuration. See Tables 2 and 3 for storable S-Registers and Commands.

The NVRAM can save up to four telephone numbers, with up to 36 digits or modifiers in each telephone number. The AT&Zn=s command will store s, the telephone number dial string. The ATDS=n command will cause the modem to dial one of the four stored telephone numbers. The NVRAM storage location for the four telephone numbers is selected by an n of 0, 1, 2, or 3.

DAA - Telephone Line Interface

High performance modems are extremely sensitive to the DAA (Data Access Arrangement) performance. The difference between a good modem and a fair one is in the DAA performance. The CH179X Family includes a specially designed low distortion DAA to achieve optimal performance over all telephone line conditions, achieving the most reliable and best performance telephone connections.

The CH179X Family is designed to meet North American telephone standards as set by FCC Part 68 and DOC. The telephone line interface is designed to meet 1000 VAC and 1500 volt peak surge isolation, among other parameters. As such it will meet U.S. and Canadian requirements and other international requirements that specify that level of isolation. The output of the CH179X Family is Tip and Ring. These two telephone line connections must be routed to an external network for improved field reliability in hostile environments, for Canadian approval, for UL compliance, and also optionally for FCC Part 15 compliance if required. See Figure 7 for network details.

Each CH179X Family component comes with FCC Part 68 approval, and a label is provided with the registration number and ringer equivalent. This label should be prominently displayed. As with most countries, except the U.S., Canada requires submission of the host product containing the CH179X Family for DOC approval. This can be done by submitting the design to a test house or consultant. Contact Cermetek for suggested consultants.

Speaker Interface

The SPK output reflects the receiver analog input and provides a signal that can be used to monitor call progress. The SPK signal is 0-2.5V peak and can drive a 300Ω load directly. The SPK signal is usually inputted to an audio power amplifier and the amplifier drives a speaker coil. Figure 3 shows how to drive an 8 Ω speaker.

The speaker can be turned on and off with an ATMn command. The speaker volume can be adjusted by the ATLn command, where n is 0, 1, 2, or 3.

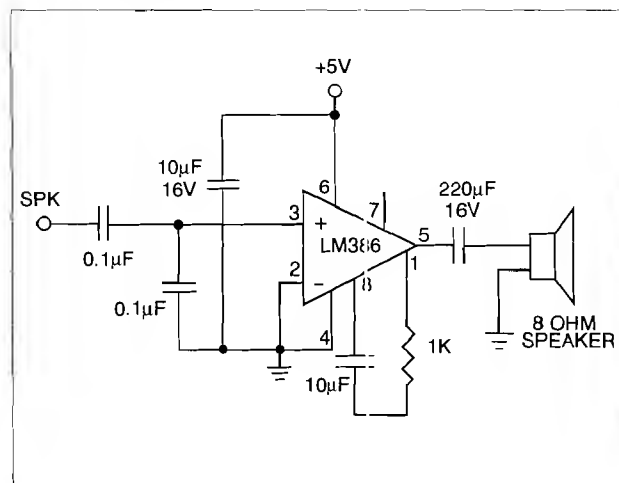


Figure 3. Speaker Control Circuit
(Optional, to allow for call progress monitoring)

ZERO POWER MODE

If an application calls for zero power during standby periods, when in the operating mode, the power may be switched off and reapplied when RI is active (see Figure 4). The CH179X can thus be powered down to zero. The controller then activates the relay or switch, supplying power (+5V) to the module. The ring signal will be used during this power down state to "wake up" the modem. Ring indication appears on the RI pin output. The RI pin follows the frequency of the ringing signal. This is normally 20 or 30 Hz for 2 seconds on and 4 seconds off.

The Pins of the CH179X will be in an undefined state when power is switched off, this must be taken into consideration when using Figure 4.

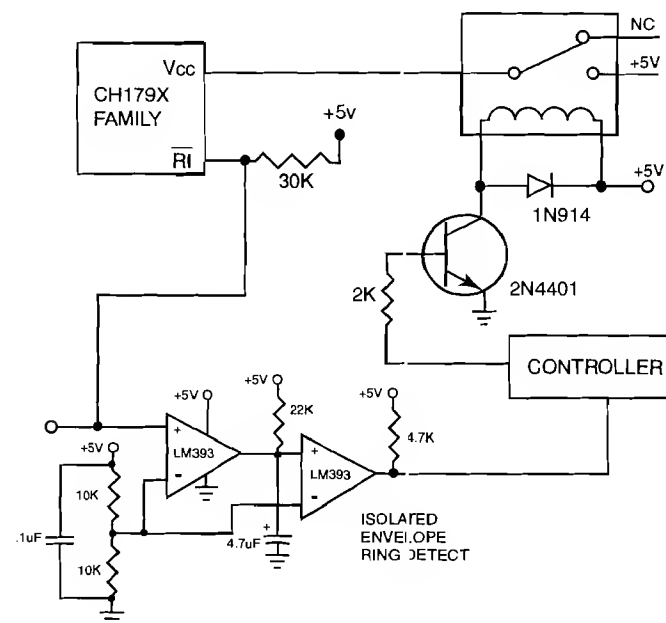


Figure 4. Zero Power Operation

POWER SUPPLY

The modem module is a complex, sensitive subsystem, and special attention should be paid to the power supply connections. The modem decodes analog signals from the telephone line that are in the millivolt range, and even though the modem is designed to withstand significant induced power supply noise, there is a limit. Steps must be taken to guarantee that power supply noise on all supply lines, including ground, does not exceed 25 mV peak to peak. If necessary, the use of dedicated power and ground planes is recommended. Failure to provide such operating conditions could cause the modem to operate inconsistently or with poor sensitivity.

The CH179X Family requires a single +5V $\pm 5\%$ supply. It is recommended that bypass capacitors be placed on the power supply line as close to the modem's supply input pins as practical. It is recommended that a 10 μ F or greater tantalum capacitor in parallel with a 0.1 μ F ceramic capacitor be used. Shield the modem from strong EMI sources nearby, such as relays, motors and power supplies.

VOICE/TONE INJECTION PORT

The CH179X Family provides a pin to allow the user to share the telephone line interface for voice and DTMF applications. Figure 5 shows the configuration for voice DTMF tone injection.

The T1 pin is coupled directly to the internal DAA of the CH179X Family. When using the modem in data mode, T1 should float and be disconnected from any potential signal source. Any signal on T1 during data operation will affect the modem's output. If T1 is being asserted from another application, use a relay or zero impedance switch to disconnect it when in data mode. The current shown in Figure 5 is a 2-to-4 wire converter Xmit, with respect to ground at RCV, with respect to ground as converter to T1 with respect to ground. Values selected achieve about a 20db minimum transhybrid loss. To maintain FCC compliance, frequency should be between 300Hz and 3000Hz. The maximum AC voltage input to the Xmit pin with respect to ground, with this circuit, is 5 V peak to peak. This will be equivalent to 0 dBm on the Telco line. The maximum output on RCV is 1.1 V peak to peak with respect to ground.

PIN COMPARISON BETWEEN CH1786 and CH1796X Family

PIN	CH1786	CH179X FAMILY
1	RING	RING
2	TIP	TIP
3	RXA	T1
4	TXA	NC
5	SPK	SPK
6	NC	NC
7	NC	NCB
8	SLEEP	OPEN*
9	NC	NC
10	TXD	TXD
11	RXD	RXD
12	V/D	OPEN*
13	DTR	DTR
14	DSR	DSR
15	RI	RI**
16	CTS(FX only)	CTS
17	DCD	DCD
18	HS	HS
19	V _{cc}	V _{cc}
20	GND	GND
21	RST	RST
22	NC	RTS

Note: * Indicates difference - the CH179X may be substituted for a CH1786 with the exception of pins 8 and 12 if used.

** Order CH179XPD for more faithful reproduction of CH1786 RI.

Note: NC- Not Connected

Figure 5. Voice/Tone Injection

All resistors are 1%, NP=non polarized capacitors. R1 can be adjusted for speaker level. Readjust R2 as required.

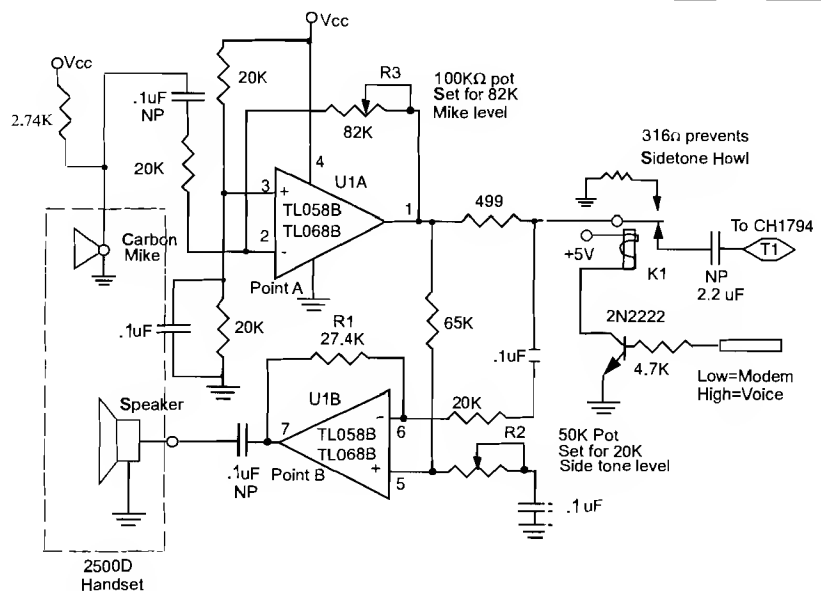


Table 1. CH179X Family Pin Descriptions

PIN	NAME	I/O	FUNCTION
1	RING	I/O	Directly connects to the telephone line's Ring lead through a user supplied RJ-11C jack
2	TIP	I/O	Directly connects to the telephone line's Tip lead through a user supplied RJ-11C jack
3	T1	I/O	ANALOG VOICE INJECTED. Input (see Figure 5). 2.2V P-P max. Let float if not used.
4	NC	I	No connection.
5	SPK	O	SPEAKER. Audio output for speaker. See speaker control diagram.
6	NC	-	No connection.
7	NC	-	No connection.
8	NC	-	No connection.
9	NC	-	No connection.
10	TXD	I	TRANSMIT DATA. Serial transmit data input. Marking, or a binary 1 condition, is transmitted when a HIGH is asserted.
11	RXD	O	RECEIVE DATA. Serial Receive data output. Received MARKING or a binary 1 condition is indicated by a HIGH.
12	NC	O	No connection.
13	$\overline{\text{DTR}}$	I	DATA TERMINAL READY INPUT. Active LOW. Switching off DTR can either return modem to command state, disconnect phone call, or reset modem. DTR should be set LOW when not used.
14	DSR	O	DATA SET READY output. LOW indicates handshaking with a remote modem is in progress, or the data carrier of a remote modem is detected.
15	$\overline{\text{RI}}$	O	RING INDICATION: This signal follows the frequency of the ringing signal (normally about 20 or 30 Hz for 2 second).
16	$\overline{\text{CTS}}$	O	CLEAR-TO SEND - output. Active LOW - Flow control
17	$\overline{\text{DCD}}$	O	DATA CARRIER DETECT output. LOW indicates a data carrier from a remote modem is detected.
18	$\overline{\text{HS}}$	O	SPEED INDICATION. High speed select output. A LOW on this pin indicates the modem is operating at highest rate.
19	VCC	-	5 Volts \pm 5% Note: Noise should be less than 25mV.
20	GND	-	GROUND.
21	RST	I	RESET input (active HIGH). This input must be asserted HIGH for at least 10 ms to reset the modem. RESET is then returned to LOW for normal operation. If no system reset is available, let this pin float to enable internal reset.
22	$\overline{\text{RTS}}$	I	REQUEST TO SEND. Active LOW - Flow control. Should be tied low if not used.

If voice and data are both being used, and the RXA and TXA pins are active, then typically voice communication precedes data communication. In which case, the following commands should be used to configure the CH179X Family:

ATS0=0 [CR] Disables auto-answer and
ATS7=255 [CR] eliminates hang-up due to
ATS10=255 [CR] lack of carrier signal.

1. To answer a voice call
 - (a) ATH1 [CR]
 - (b) Switch local voice source into RXA and TXA
 - (c) Begin voice conversation.
2. To switch to data mode, switch local voice source from RXA and TXA
 - (a) At the Originating modem execute:
ATX1 [CR]
 - (b) At the Answering modem execute:
ATA [CR]
3. To disconnect (hang-up) a voice call or a data call, return to control mode by +++:
Then, ATH [CR]
4. To place a voice call using the CH179X Family's DTMF facilities:
 - (a) ATDT(Tele)#; [CR]
 - (b) Then switch to local voice source

WARNING: The CH179X Family has been FCC Part 68 Approved as a data modem. Utilization of the Voice/Tone Port requires further registration. FCC will require that the system, including the CH179X Family and the handset or DTMF transceiver, adhere to Part 68 rules.

MODEM CONTROL

The CH179X Family modem may be controlled by sending serial ASCII command sequences. The commands are sent to the modem serially on TXD. After execution of the command, the modem returns a status message on RXD, to indicate command is executed.

Power-up Reset

After applying power to the modem, an internally generated reset pulse is created. The user can also reset the modem externally by applying the high-going reset pulse to RST for at least 10ms after the +5V power supply has stabilized. Delay sending commands to CH179X Family for 300-900ms after reset.

Training the Modem

The modem must be trained to match the host's speed and parity so that it is able to recognize serial asynchronous commands sent to it by the host UART. The modem is trained by sending it the following three character sequence.

AT[CR]

where: A and T is upper case,

[CR] represents carriage return

The modem will respond with one of the following status messages, depending on whether it is optioned for abbreviated or English status messages:

0[CR] (Abbreviated form)

[CR][LF][OK][CR][LF] (English form)

where: [CR] represents carriage return (ASCII 13)
[LF] represents line feed (ASCII 10)

The modem may be retrained any time while it is idle.

Another attention sequence "A" is much like the "AT" sequence except it repeats the previously entered command specified with an "AT" prefix. When given, it must also be in upper case ASCII. No carriage return is needed

The modem will come up in its default state - 14.4kbps for the CH1794, 28.8kbps for the CH1798, and 33.6kbps for the CH1799 - on power up, or when reset is initiated either by command (ATZ) or by the RST pin. If desired, any speed, error correction, or data compression can be locked in, using the AT+Vn and/or AT+Ms command.

THE COMMAND FORMAT

Typical commands consist of three elements, the attention sequence, the commands themselves, and a terminating carriage return.

AT[commands][CR]

where: [CR] represents carriage return (ASCII 13)

When entering commands to the modem, the backspace character - control-H (ASCII 8) - can be used to edit mistakes. "AT" and "A" may not be edited however. Multiple commands may be placed in the command line. A command line may be as long as 37 characters, excluding AT. The command below instructs the modem to configure itself to not echo characters in the command mode (E0) and then go to answer mode. Note the lack of punctuation between string commands, and spaces are ignored.

ATE0A[CR]

AT Command Set

See Table 3 for a summary list of AT commands. Detailed command descriptions are available upon request.

THE STATUS MESSAGES and RESULT CODES

The modem responds with a status message after each command is executed and result codes after a modem connection is made or attempted. The status messages may either be up to two digits (terse), followed by a carriage return or may be a carriage return and line feed with a message in English (verbose) followed by a carriage return and line feed. Short form and long form respectively, see Table 2.

All AT commands, other than dialing commands, will be responded to with either an OK (0) if the command is valid or accepted, or with an error (4) if the command is not recognized. All other messages fall in the category of call progress status or result codes. Such as: Ring (2) - while the remote modem is being called, each ring will be signaled to the DTE. No answer (8) will indicate a failed connection attempt. When the modem connects, result codes will be signaled to the DTE. Result codes, non-extended, from 9 - 35 are in Table 2. Result codes extended beyond 35 can be optionally selected with the Attn command and status register S35. It is recommended that the non-extended result codes be used in all cases, and particularly used for the CH1799.

The (default) connect messages 9 - 17 indicate a connection at a given DTE speed, not Carrier (Line) speed. Hence a CH1794 will connect at maximum speed of 19,200 (15). The CH1798 and CH1799 will connect at 38,400 (17) unless DTE is forced to a higher speed connection by selection of data compression, in which case the maximum DTE to modem speed is 115,200 (19). Certain subsets of status and result codes can be specified by the ATXn command.

The basic status code subsets are enabled with the Xn command. Where n=0,1,2,3,4 the status codes can be in message form or result code form. See the detailed description of the ATXn command for result code options.

Extensions to the basic set can be specified by Register S95, which covers result codes 40 - 81.

Options with S95 are:

Enable compression result codes 66, 67, 69

Enable error protocol result codes 76, 77, 80, 81

Enable carrier result codes 40 - 58

Enable DCE rather than DTE speed result codes 59 - 64

Note: Result codes 53 - 64 are only supported by CH1798 and CH1799. To obtain a detailed status report of a given modem communication, use the ATV1 command. When this command has been executed at setup, the modem will return a connect message on line consisting of <DTE speed> <modulation> <error protocol> <line speed of connection>.

TABLE 2.
(ATXn)

Terse		Verbose					Result Codes				
Short	Long Form	0	1	2	3	4	0	1	2	3	4
0	OK	x	x	x	x	x	x	x	x	x	x
1	CONNECT	x	x	x	x	x	x	x	x	x	x
2	RING	x	x	x	x	x	x	x	x	x	x
3	NO CARRIER	x	x	x	x	x	x	x	x	x	x
4	ERROR	x	x	x	x	x	x	x	x	x	x
5	CONNECT 1200	1	x	x	x	x	x	x	x	x	x
6	NO DIAL TONE	3	3	x	x	x	x	x	x	x	x
7	BUSY	3	3	3	x	x	x	x	x	x	x
8	NO ANSWER	x	x	x	x	x	x	x	x	x	x
9	CONNECT 0600	1	x	x	x	x	x	x	x	x	x
10	CONNECT 2400	1	x	x	x	x	x	x	x	x	x
11	CONNECT 4800	1	x	x	x	x	x	x	x	x	x
12	CONNECT 9600	1	x	x	x	x	x	x	x	x	x
13	CONNECT 7200	1	x	x	x	x	x	x	x	x	x
14	CONNECT 12000	1	x	x	x	x	x	x	x	x	x
15	CONNECT 14400	1	x	x	x	x	x	x	x	x	x
16	CONNECT 19200	1	x	x	x	x	x	x	x	x	x
17	CONNECT 38400	1	x	x	x	x	x	x	x	x	x
18	CONNECT 57600	1	x	x	x	x	x	x	x	x	x
19	CONNECT 115200	1	x	x	x	x	x	x	x	x	x
22	CONNECT 75TX/1200RX	1	x	x	x	x	x	x	x	x	x

23	CONNECT 1200TX/75RX	1	x	x	x	x
24	DELAYED	4	4	4	4	x
32	BLACKLISTED	4	4	4	4	x
33	FAX	x	x	x	x	x
35	DATA	x	x	x	x	x
40	CARRIER 300	x	x	x	x	x
44	CARRIER 1200/75	x	x	x	x	x
45	CARRIER 75/1200	x	x	x	x	x
46	CARRIER 1200	x	x	x	x	x
47	CARRIER 2400	x	x	x	x	x
48	CARRIER 4800	x	x	x	x	x
49	CARRIER 7200	x	x	x	x	x
50	CARRIER 9600	x	x	x	x	x
51	CARRIER 12000	x	x	x	x	x
52	CARRIER 14400	x	x	x	x	x
53	CARRIER 16800	x	x	x	x	x
54	CARRIER 19200	x	x	x	x	x
55	CARRIER 21600	x	x	x	x	x
56	CARRIER 24000	x	x	x	x	x
57	CARRIER 26400	x	x	x	x	x
58	CARRIER 28800	x	x	x	x	x
59	CONNECT 16800	1	x	x	x	x
61	CONNECT 21600	1	x	x	x	x
62	CONNECT 24000	1	x	x	x	x
63	CONNECT 26400	1	x	x	x	x
64	CONNECT 28800	1	x	x	x	x
66	COMPRESSION: CLASS 5	x	x	x	x	x
67	COMPRESSION: V.42bis	x	x	x	x	x
69	COMPRESSION: NONE	x	x	x	x	x
76	PROTOCOL: NONE	x	x	x	x	x
77	PROTOCOL: LAPM	x	x	x	x	x
80	PROTOCOL: ALT	x	x	x	x	x
84	CONNECT 33600	x	x	x	x	x
91	CONNECT 31200	x	x	x	x	x
150	CONNECT 32000	x	x	x	x	x
+F4	+FC ERROR	x	x	x	x	x

Note: 1. An >x= in a column indicates that the message (either the long form if verbose, or the value only for short form) will be generated when that particular value of >n+ (shown at the top of the column) has been selected by the use of ATXn. A numeral indicates which less explicit message (verbose or short form) will be output for that X option.

BASIC AT COMMANDS:

COMMAND	FUNCTION	COMMAND	FUNCTION
A/	Re-execute command	X0	Report basic call progress result codes, i.e. OK, CONNECT, RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR
A	Go off-hook and attempt to answer a call	X1	Report basic call progress result codes and connections speeds, i.e. OK, CONNECT, RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER, CONNECT XXXX, and ERROR
B0	Select V.22 connection at 1200bps	X2	Report basic call progress result codes and connections speeds, i.e. OK, CONNECT, RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER, CONNECT XXXX, NO DIAL TONE and ERROR
B1	Select Bell 212A connection at 1200bps	X3	Report basic call progress result codes and connection rate, i.e. OK, CONNECT, RING, NO CARRIER, NO ANSWER, CONNECT XXXX, BUSY and ERROR
C1	Return OK message	X4	Report all call progress result codes and connection rate, i.e. OK, CONNECT, RING, NO CARRIER, NO ANSWER, CONNECT XXXX, BUSY, NO DIAL TONE and ERROR
Dn	Dial modifier	Y0	Disable long space disconnect before on-hook
P	Pulse Dial	Y1	Enable long space disconnect before on-hook
T	Touch Tone Dial	Z0	Restore stored profile 0 after warm reset
W	Wait for Dial Tone	Z1	Restore stored profile 1 after warm reset
;	Return to Idle State	&C0	Force RLSD active regardless of the carrier state
@	Wait for Quiet Answer Command	&C1	Allow RLSD to follow the carrier state
!	Flash Hook	&D0	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6 The modem ignores DTR
,	Pause	&D1	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6 Asynchronous escape
0-9/ABCD	Dial Digits/Characters	&D2	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6 The modem hangs up
&	Wait for credit card dial tone	&D3	Interpret DTR On to OFF transition per &Qn: &Q0, &Q5, &Q6 The modem performs soft reset.
^	Toggles calling tone		
L	Redial last number		
*	Star digit - tone dialing		
S=n	Dial the number and store in directory. N=0 to 3		
E0	Turn off command echo		
E1	Turn on command echo		
H0	Initiate a hang-up sequence		
H1	If on-hook, go off-hook and enter command mode		
L0	Set low speaker volume		
L1	Set low speaker volume		
L2	Set medium speaker volume		
L3	Set high speaker volume		
M0	Turn speaker off		
M1	Turn speaker on during hand shaking and turn speaker off while receiving carrier		
M2	Turn speaker on during hand shaking and while receiving carrier		
M3	Turn speaker off during dialing and receiving carrier and turn speaker on during answering		
N0	Turn off automode detection		
N1	Turn on automode detection		
O0	Go on-line		
O1	Go on-line and initiate a retrain sequence		
Q0	Allow result codes to DTE		
Q1	Inhibit result codes to DTE		
Sn	Select S-Register as default		
Sn?	Return the value of S-Register n		
Sn=v	Set default S-Register to value v		
V0	Report short form (terse) result codes		
V1	Report long form (verbose) result codes		
W0	Report DTE speed in EC mode		
W1	Report line speed, EC protocol and DTE speed		
W2	Report DCE speed in EC mode		

BASIC AT COMMANDS - Continued:

Command	Function
&F0	Restore factory configuration 0
&F1	Restore factory configuration 1
&G0	Disable guard tone
&G1	Disable guard tone
&G2	Enable 1800 Hz guard tone
&K0	Disable DTE/DCE flow control
&K3	Enable RTS/CTS DTE/DCE flow control
&K4	Enable XON/XOFF DTE/DCE flow control
&K5	Enable transparent XON/XOFF flow control
&K6	Enable both RTS/CTS and XON/XOFF flow control
\Kn	Controls break handling during three states: When modem receives a break from the DTE:
\K0,2,4	Enter on-line command mode, no break sent to the remote modem
\K1	Clear buffers and send break to remote modem
\K3	Send break to remote modem immediately
\K5	Send break to remote modem in sequence with transmitted data
	When modem receives \B in on-line command state:
\K0,1	Clear buffers and send break to remote modem
\K2,3	Send break to remote modem immediately
\K4,5	Send break to remote modem in sequence with transmitted data
	When modem receives break from remote modem:
\K0,1	Clear data buffers and send break to DTE
\K2,3	Send a break immediately to DTE
\K4,5	Send a break with received data to DTE
\N0	Select normal speed buffered mode
\N1	Select direct mode
\N2	Select reliable link mode
\N3	Select auto reliable mode
\N4	Force LAPM mode
\N5	Force MNP mode
\V0	Connect messages are controlled by the command settings X, W, and S95
\V1	Connect messages are displayed in the single line format
+MS	Select modulation

ERROR CORRECTING COMMANDS

%C0	Disable data compression
%C1	Enable MNP 5 data compression
%C2	Enable V.42bis data compression
%C3	Enable both V.42bis and MNP5 compression
\A0	Set maximum block size in MNP to 64
\A1	Set maximum block size in MNP to 128
\A2	Set maximum block size in MNP to 192
\A3	Set maximum block size in MNP to 256
\Bn	Send break of n x 100 ms
&M0	Select direct asynchronous mode
&P0	Set 10 pps pulse dial with 39%/61% make/break
&P1	Set 10 pps pulse dial with 33%/67% make/break
&P2	Set 20 pps pulse dial with 39%/61% make/break

COMMAND

FUNCTION

&P3	Set 20 pps pulse dial with 33%/67% make/break
&Q0	Select direct asynchronous mode
&Q5	Modem negotiates an error corrected link
&Q6	Select asynchronous operation in normal mode
&T0	Terminate any test in progress
&T1	Initiate local analog loopback
&T2	Return ERROR result code
&T3	Initiate local digital loopback
&T4	Allow remote digital loopback
&T5	Disallow remote digital loopback request
&T6	Request an RDL without self-test
&T7	Request an RDL with self-test
&T8	Initiate local analog loop with self-test
&V	Display current configurations
&W0	Store the active profile in NVRAM profile 0
&W1	Store the active profile in NVRAM profile 1
&Y0	Recall stored profile 0 upon power up
&Y1	Recall stored profile 1 upon power up
&Zn=x	Store dial string x (to 34) to location n (0 - 3)
%E0	Disable line quality monitor and auto retrain
%E1	Enable line quality monitor and auto retrain
%E2	Enable line quality monitor and fall back/

MNP 10 COMMANDS

-K0	Disable MNP 10 extended services
-K1	Enable MNP 10 extended services
-K2	Enable MNP 10 extended services detection only

FAX CLASS 1

+FCLASS=n	Service Class
+FAE=n	Data/fax auto answer
+FRH=n	Receive data with HDLC framing
+FRM=n	Receive data
+FRS=n	Receive silence
+FTH=n	Transmit data with HDLC framing
+FTM=n	Transmit data
+FTS=n	Stop transmission and wait

Table 4. S-Register Summary for CH179X Family

Register	Function	Range	Units	Saved	Default
S0	Rings to Auto-Answer	0-255	rings	*	0
S1	Ring Counter	0-255	rings		0
S2	Escape Character	0-255	ASCII	*	43
S3	Carriage Return character	0-127	ASCII		13
S4	Line Feed Character	0-127	ASCII		10
S5	Backspace Character	0-255	ASCII		8
S6	Wait Time for Dial Tone	2-255	s		2
S7	Wait Time for Carrier	1-255	s		50
S8	Pause Time for Dial Delay Modifier	0-255	s	*	2
S9	Carrier Detect Response Time	1-255	0.1s	*	6
S10	Carrier Loss Disconnect Time	1-255	0.1s	*	14
S11	DTMF Tone Duration	50-255	0.001s	*	95
S12	Escape Prompt Delay	0-255	0.02s	*	50
S13	Reserved	-	-		-
S14	General Bit Mapped Options Status	-	-	*	138 (8Ah)
S15	Reserved	-	-		-
S16	Test Mode Bit Mapped Options Status (&T)	-	-		0
S17	Reserved	-	-		-
S18	Test Timer	0-255	s	*	0
S21	V.24/General Bit Mapped Options Status	-	-	*	52 (34h)
S22	Speaker/Results Bit Mapper Options Status	-	-	*	117 (75h)
S23	General Bit Mapped Options Status	-	-	*	62 (3Dh)
S24	Reserved	-	-		-
S25	Delay to DTR Off	0-255	s or 0.01s		5
S26	RTS-to-CTS Delay	0-255	0.01s		1
S27	General Bit Mapped Options Status	-	-	*	73 (49h)
S28	General Bit Mapped Options Status	-	-	*	0
S30	Disconnect Inactivity Timer	0-255	10s		0
S31	General Bit Mapped Options Status	-	-	*	94 (C2h)
S32	XON Character	0-255	ASCII		17 (11h)

Register	Function	Range	Units	Saved	Default
S33	XOFF Character	0-255	ASC11		19 (13h)
S34-S35	Reserved	-	-		-
S36	LAPM Failure Control	-	-	*	7
S37	Line Connection Speed	-	-	*	0
S38	Delay before Forced Hang up	0-255	s		20
S39	Flow Control Bit Mapped Options Status	-	-	*	3
S40	General Bit Mapped Options Status	-	-	*	104 (68h)
S41	General Bit Mapped Options Status	-	-	*	195 (C3h)
S42-S45	Reserved	-	-		-
S46	Data Compression Control	-	-	*	138
S48	V.42 Negotiation Control	-	-	*	7
S82	LAPM Break Control	-	-		128 (40h)
S86	Call Failure Reason Code	0-255	-		-
S95	Result Code Messages Control	-	-	*	0

MODEM STATES

The modem can be in either a command mode or a data mode. When the modem is idle, it is in the command state. When a data call is in progress it is in the data mode state. The modem does not recognize commands when in the data mode. To recognize commands the computer must send an "escape sequence" to the modem that forces it out of the data mode and into the command mode. The escape sequence consists of a "guard time" (a period where no characters are sent to the modem), followed by 3 escape characters, followed by a "guard time" again. At power up the guard time is set to 1 second minimum and the escape character is set as "+". These two parameters can be modified via registers S2 and S12, see Table 4. The modem will stay off-hook with its carrier on after the escape sequence is received. It returns an OK status message when it is ready to accept commands. You may reenter the data mode by issuing the ONLINE command ATO[CR].

"AT" COMMAND APPLICATIONS

Pause

When placing a call from an office with a telephone connected to a PBX it may be necessary to dial an access code (usually the digit 9) to get an outside line. Inserting a comma in the telephone number commands the modem to pause for a specific length of time. The factory default pause time is 2 seconds.

Example: Dial 9, pause, dial number.

Enter: ATDT9, T1234567

Multiple commas may be used for a greater delay time.

Touch Tone and Pulse Dialing "T" and "P"

The modem can use DTMF (touch-tones) "T," or dial pulses "P" when dialing a telephone number. If the dial command does not specify which type to use, the modem defaults to the type last specified. The power-on default value is T.

Example: Pulse dial 9, pause, touch-tone dial number

Enter: ATDP9, T1234567

Redial Last Number "A"

Use A/, the repeat command, to redial the last telephone number dialed when a busy signal is received.

Return to Command State ";"

The modem can be forced to reenter the command state after dialing (without hanging up) by ending the dial command with a semi-colon. This is useful when using the modem as an auto dialer.

Example: Touch-tone dial 9, pause dial number, return for

Automatic Answering

The S0 register controls the number of rings that must occur before the modem answers a call. The register may range in value from 0-255.

S0=0	DO NOT ANSWER TELEPHONE
S0=1-254	ANSWER ON RING 1 TO RING 254
S0=255	ANSWER ON RING 255

*When S0 is set to 0, the modem will not auto-answer.

Dial a Number "D"

The Dial command takes the form Dn, where "n" is a string of characters. In the simplest form, "n" will be only the digits of the phone number to be dialed.

Example: Dial number.
Enter: ATD5554567

In response to this command, the modem dials the telephone number "555-4567" and then waits for carrier from a distant modem. If no carrier is detected within a given time (the default time is 30 seconds), the modem automatically releases the line and sends a NO CARRIER result code. If carrier is detected, the modem gives a CONNECT result code and goes on-line, permitting communication with the distant modem.

The Dial Command may also be issued without a telephone number. ATD causes the modem to pick up the telephone line without dialing a number.

CONNECTING TO THE HOST UART

Since a modem communicates data serially and most host products handle data in a parallel format, a UART is needed to make parallel-to-serial and serial-to-parallel translations.

THE SERIAL INTERFACE LINES

The module supports a full RS-232C/V.24 serial interface. Signal levels are TTL rather than RS-232C level compatible, which allows to directly connect the modem to the host's UART without level translating circuitry. A complete description of each signal follows under Pin Description. See Table 1.

A minimum of two of these lines must be utilized for proper modem operation: TXD and RXD. The modem is controlled by sending it serial commands over TXD and can be monitored by serial status messages returned on RXD. All other serial interface lines may be utilized for the convenience of your application but are not required by the modem. Unused outputs (from modem) should be left unconnected. Unused inputs should be tied to the proper logic level. See Table 1.

PHONE LINE CONNECTION GUIDELINES

- 1) The mounting of the CH179X Family in the final assembly must be made so that it is isolated from exposure to any hazardous voltages within the assembly. Adequate separation and restraint of cables and cords must be provided.
- 2) The circuitry from the CH179X Family to the telephone line Interface must be provided in wiring that carries no other circuitry than that specifically allowed in the rules (such as A and A1 leads).
- 3) Connection to the phone line should be made through a telephone approved RJ-11 jack.
- 4) Traces from the modem's RING and TIP pins to the ancillary protection circuitry and RJ-11 jack must exceed 0.1 inch spacing to one another and 0.2 inch spacing to all other traces. The traces should have a nominal width of 0.020 inches or greater.

5) The RING and TIP traces should be as short as possible and oriented to prevent coupling extraneous high speed or high frequency signals into the modem.

6) No additional circuitry other than that shown in the following Figure 7 may be connected between the modem module and the RJ-11 jack.

7) The CH179X Family, the RJ-11 jack and the interfacing circuitry and traces in between, must be mounted on a circuit board with a 94 V-0 flammability rating.

8) The supplied FCC registration label must be applied visibly on the outside of the host product. The rear or underside of a product will do.

9) The host product's User Manual must provide the user with instructions for connection and use as recommended in Section FCC Registration.

CANADIAN APPROVALS

The CH179X Family can additionally be approved for Canadian telephone connections. This must be done, however, after the modem is installed in the host product. The entire host product must then be submitted to the DOC for approval. Cermetek offers a list of consultants to assist you with the process.

MOUNTING THE MODEM

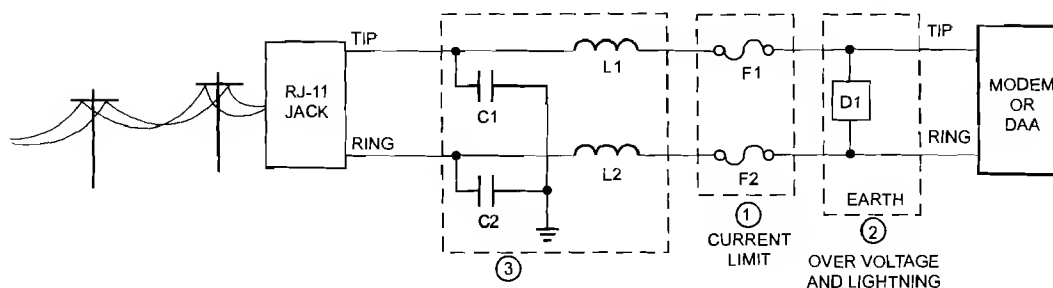
The modem contains static sensitive devices and should only be handled by personnel and in areas that are properly protected against static discharge.

There are two mounting techniques that are recommended for physically connecting the modem to your circuit card; 1) sockets, and 2) direct soldering. Each approach has its own set of benefits and challenges.

This part is not hermetically sealed; water or chemical intrusion into the case can cause malfunction and void the warranty.

The socketing approach to mounting eliminates cleaning and desoldering concerns. When a socket is used, it must make a solid connection to all modem pins. Failure to do so will cause unreliable modem operation. Also, steps should be taken to assure that the module remains tightly seated in the socket after the host product is shipped.

Figure 6. CH179X Family Telephone Line Interfaces



*1) Current Line Device: F1 and F2 amp

A. UL 1459 must use a current limit device. A Raychem Poly Fuse TR 600-150 is recommended as this device resets automatically after each power surge. Acceptable devices are fuses from Little Fuse, type 251.250, or Cooper Ind., Bussman Div., Type MCR 1/4.

B. Resistors (10 ohm carbon film or SMD 1/8W min.) can be used for non UL applications.

*2) Over Voltage and Lightning Protection

A. The Device is provided with an internal sidactor device that protects from metallic voltage surges.

B. DOC (Canada) may require current limit devices external to the module. Use 10hm resistors (carbon film or SMD parts 1/8W min.) in each (Tip and Ring). You may substitute fuses or the Poly Fuse described in Section 2.

C. For lightning prone areas where there are more than 2 storms per year. Provide an earth ground connection and the following part, (this is FCC or DOC acceptable). Teccor Sidactors P3203AB or P3100BA70. These devices give metallic and longitudinal protection for the modem. This must also include the current protection in Section 2.

3) EMI/RFI Suppression

The capacitor/inductor network should be located as close to the RJ-11 Jack as possible with an excellent ground path to the chassis. Capacitors C1 and C2 should not exceed .005uF. They must have a rating of 1.5 KV and typically are on .001uF +/- 20%. Inductors L1 and L2 are Fair-Rite 2643666611 or 2943666661. These are ferrite cylinders and provide attenuation to high frequencies from system level components beyond the modem. These values to be adjusted per product design.

*Mandatory for reliable operation.

FCC REGISTRATION

The CH179X Family is registered with the FCC (Federal Communications Commission) under Part 68. To maintain the validity of the registration, you must serve notice to the end user of the product that contains the modem of several restrictions the FCC places on the modem and its use. The following notice is recommended and should be included in the host product's USER MANUAL. Also, the FCC requires that Cermetek make all repairs to the modem. If repair is necessary after the modem is installed in your product and has been delivered to your customer, the modem must be returned to you where it can be removed from the host product and then forwarded to Cermetek for repair.

Changes in Attestation Procedure for Plugs and Jacks

The user must attest that the network interface plugs or jacks used on this equipment, and not supplied by Cermetek, comply with and will continue to comply with the mechanical requirements specified in Part 68, Subpart F, specifically the dimensions, tolerances and metallic plating requirements. The compliance of these connectors will be assured by purchase specifications and incoming inspection from your vendor. Documentation of such specifications and /or inspections will be provided the FCC within 30 days of their request for the same.

FOR YOUR USER'S MANUAL

The part 68 rules require the following or the equivalent information be provided to the end user of equipment containing a pre-approved modem module.

Type of Service: The (insert your product name) is designed to be used on standard device telephone lines connects to the telephone line by means of a standard jack called the USOC RJ-11C (or USOC FJ45S). Connection to telephone company provided coin service (central office implemented systems) is prohibited. Connection to party lines service subject to state tariffs.

Telephone Company Procedures: The goal of the telephone company is to provide you with the best service it can. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations or procedures. These changes might affect your service or the operation of your equipment, the telephone company will give you notice, in writing, to allow you to make any changes necessary to maintain uninterrupted service.

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment which you have connected to your telephone line. Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN); both of these items are listed on the equipment label. The sum of all of the RENs on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

If Problems Arise: If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given the opportunity to correct the problem and informed of your right to file a complaint with the FCC. Contact your telephone company if you have any questions about your phone line. In the event repairs are ever needed on the (insert your product name), they should be performed by (insert your company name) or an authorized representative of (insert your company name). For information contact: (insert your company address).

DEFAULT STATUS, PERFORMANCE AND SPECS

Default Connect Speeds are 14,400bps, 28,800bps, 33,600bps	Ring count – 00
for CH1794, CH1798, and CH1799 respectively	Escape code character = 43 (+)
Serial port data rate auto baud enabled	Flash to on hook = 70 ms
Bell 212A operation at 1200bps	Auto speed detection enabled
Parity - none	DTE connect speed, connect messages
Auto answer disabled	Back space character = 08 (BS)
Command echo ON	Carriage return character = 13 (Cr)
All result codes enabled – except \REL codes	Line feed character = 10 (LF)
Wait for dial tone before dialing – 2 seconds	Duration of wait for dial tone = 02 seconds
Dials with touch-tone (T)	Duration of wait for carrier after dialing = 50 seconds
Detects busy signal (ATX4)	Carrier detect response time = 0.6 seconds
Full word result codes - non-extended	Escape code guard time = 1 second
Pulse dial make/break ratio = 39/61- 10 psp	Length of use after comma = 2.0 seconds
Test timer set to 0 seconds, test modes disabled	Last carrier to hang up delay = 1.4 seconds
Inactivity timer set to 0 minutes	DTMF interdigit delay = .095 seconds
CTS always active	Auto sync address or address detection = 0
DSR is ignored	Connection detected at DTE - Highest speed 38,400bps
DCD is ignored	Auto retrain enabled - 30 seconds attempt
RTS to CTS delay - .01 seconds	MNP error correction mode can be negotiated (&Q5)
DTR always active - hangs up after transition	MNP - non-extended service selected
Long space disconnect disabled	MNP error correction block size is 128 characters selected
Speaker enabled but off when receiving carrier	Data compression -negotiation enabled
Speaker volume set to low	Transmit break length is 0.3 seconds
Local modem will not grant RDL request from remote modem	All breaks are transmitted in sequence with data
Guard tones disabled	Serial port flow control enabled := RTS/CTS
Minimum DTR pulse width = .05 seconds	XON/XOFF flow control characters selected

NOTE: Upon power-up modem will recall user profile 0 which may override the above Factory Defaults.

CH179X Family Electrical Specifications

$T_A = 0^{\circ}\text{C}$ to 50°C . $V_{cc} = +5\text{V} \pm 5\%$ Noise not to exceed 25mV peak
CH179X Family ET - -40°C + 85°C

TABLE 5.

Parameter	Description	Minimum	Typical	Maximum	Unit
V _{cc}	Positive Supply Voltage	4.5	5.0	5.5	V
I _{cc} Off Hook (CH1794)	Nominal Operating Current @ V _{cc} = 5.5V when modem is Off Hook		115		mA
I _{cc} Off Hook (CH1798/99)	Nominal Operating Current @ V _{cc} = 5.5V when modem is Off Hook		185		mA
V _{IH}	High Level Input Voltage*	2			V
V _{IL}	Low Level Input Voltage*			0.8	V
VT+	Positive Hysteresis Threshold for RESET pin		2.5		V
VT-	Negative Hysteresis Threshold for RESET pin		0.5		V
V _{OH}	High Level Output (I _{OH} = 0.5 mA) *	2.4			V
V _{OL}	Low Level Output (I _{OL} = 1.6 mA) *			0.6	V

TABLE 6.

Parameter	Minimum	Typical	Maximum	Units	Comments
Off Hook Impedance	20			MΩ	
Trans hybrid Loss		25		dB	600Ω, RXA, TXA
Ring Voltage Loop	110V		250V	V _p top	On 48VDC line voltage for sustained periods
Line Loop Current - (Off-Hook)		20	100	mA	
Return Loss @ 1000 Hz		15		dB	600Ω
Ring Frequencies		40		Hz	
Receiver Insertion Gain - 0.5	0.0	+0.5	dB		
Transient Power		-9.5		dB	600Ω - Data Mode
First Character After Reset	0.5	1.0		sec	Delay
Inter Character Delay	20	50		Msec	Between all command characters
Command Delay	100	200		Msec	Between all AT commands
Minimum Reset Pulse					If user supplied

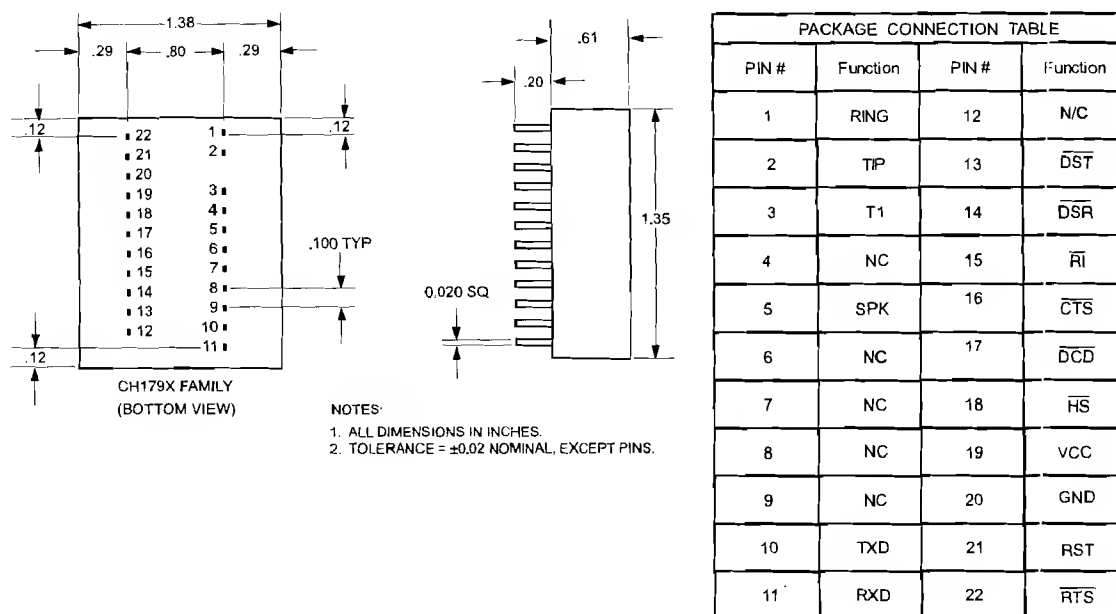


Figure 7. Physical Dimensions & Pin Functions



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